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4th Generation M3 Chassis Dynamics

Model: E90, E92

Production: 2/2008

OBJECTIVES

After completion of this module you will be able to:

- Identify the changes made to the suspensions of the M3 when compared to the series production E92.
- Explain the components used in the steering system of the M3.
- Identify the version of DSC used.
- Identify the braking system upgrades made to the M3 when compared to the series production E92.

Chassis and Suspension

The chassis of the E92 M3 is based on the chassis of the series model E92. All modifications are described in this section.



E92 M3 Chassis

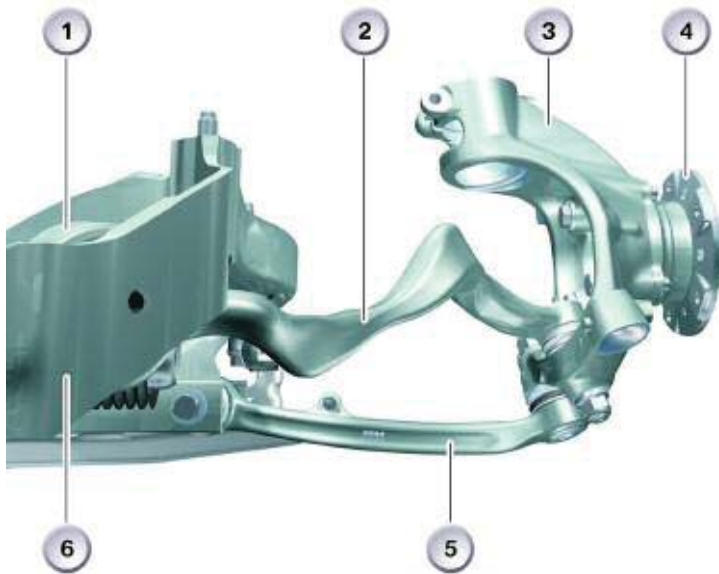
Designation	E92 M3	Series E92 335i
Tire type/Wheel rim type/Rim offset [mm]	245-40 ZR 18/8.5Jx18/IS29	225-45 WR 17 RSC/8Jx17/IS34
Tire radius [mm]	305	295
Wheelbase [mm]	2761	2760
Track width [mm]	1538	1500
Total toe	16'	14'
Toe differential angle	2° 14'	1° 40'
Camber	-1°	-18'
Kingpin inclination	15° 2'	14° 7'
Kingpin offset [mm]	8.4	5.1
Trail [mm]	29.4	20.3
Trail angle	7° 8'	7° 5'

Front End

Components of the double-jointed spring strut front axle



Complete front axle



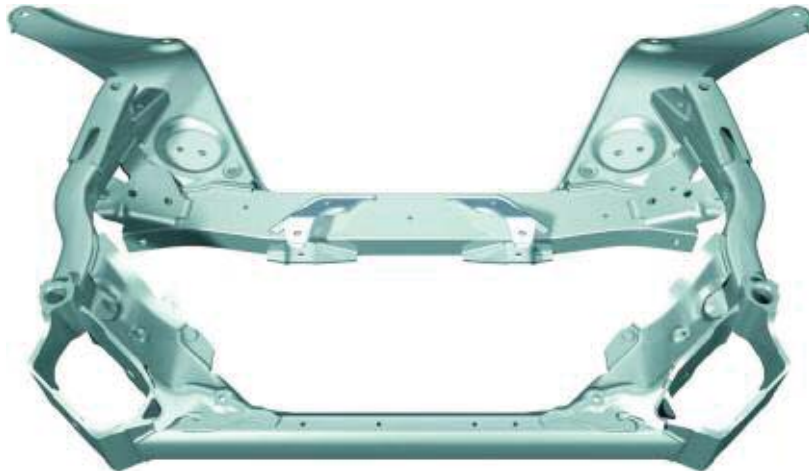
Wheel suspension components

Index	Explanation	Index	Explanation
1	Rubber mount for tension strut	4	Wheel hub
2	Tension strut	5	Wishbone
3	Swivel bearing	6	Front axle carrier

Front Axle Carrier

The front axle carrier is an aluminum alloy construction. In order to ensure optimum strength and torsional rigidity, a high-pressure forming technique has been used to manufacture certain sections.

Aluminum has been chosen for its lightweight and strength properties. The components of the front axle are joined together by an aluminum welding process.



Front axle carrier

Swivel Bearing

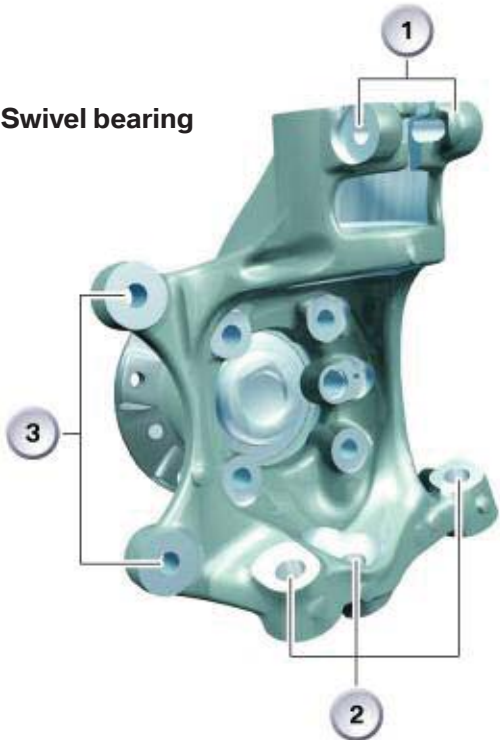
The 'M' swivel bearing is completely new. The bearing is made from an aluminum cast alloy, which reduces the weight by 500 grams.

The following changes have been made to the front wheel carrier:

- Adjusted dimensions for the larger 'M' wheel.
- As described below, the method by which the spring strut is clamped into the swivel bearing has been changed.
- The geometric fixing points for the wishbone, tension strut and steering track rod have been selected to ensure optimum sports vehicle kinematics.
- Modified mounting position for the larger brake caliper.



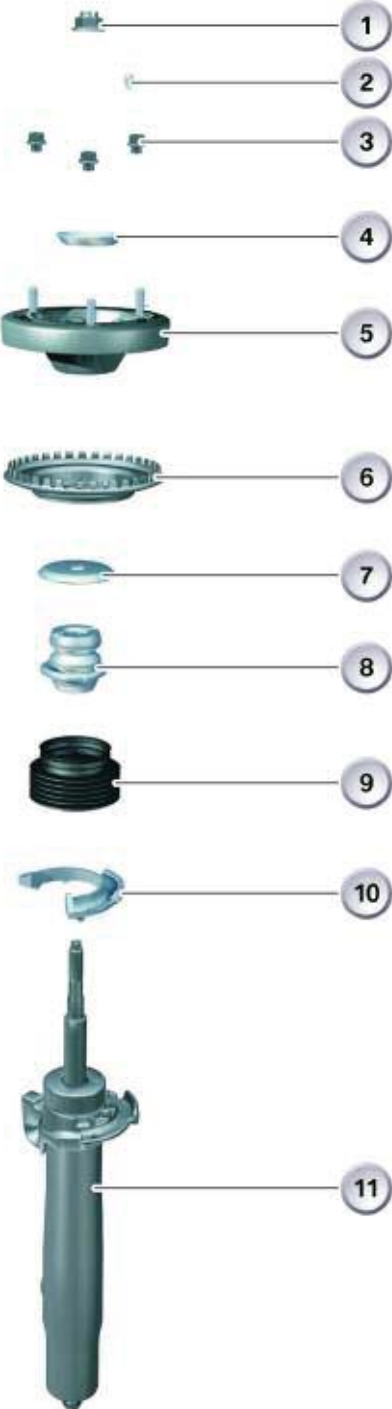
Swivel bearing



Index	Explanation
1	Clamp connection of the spring strut support
2	Attachment points for the tension strut, wishbone and steering track rod
3	Brake caliper mounting

Spring Strut

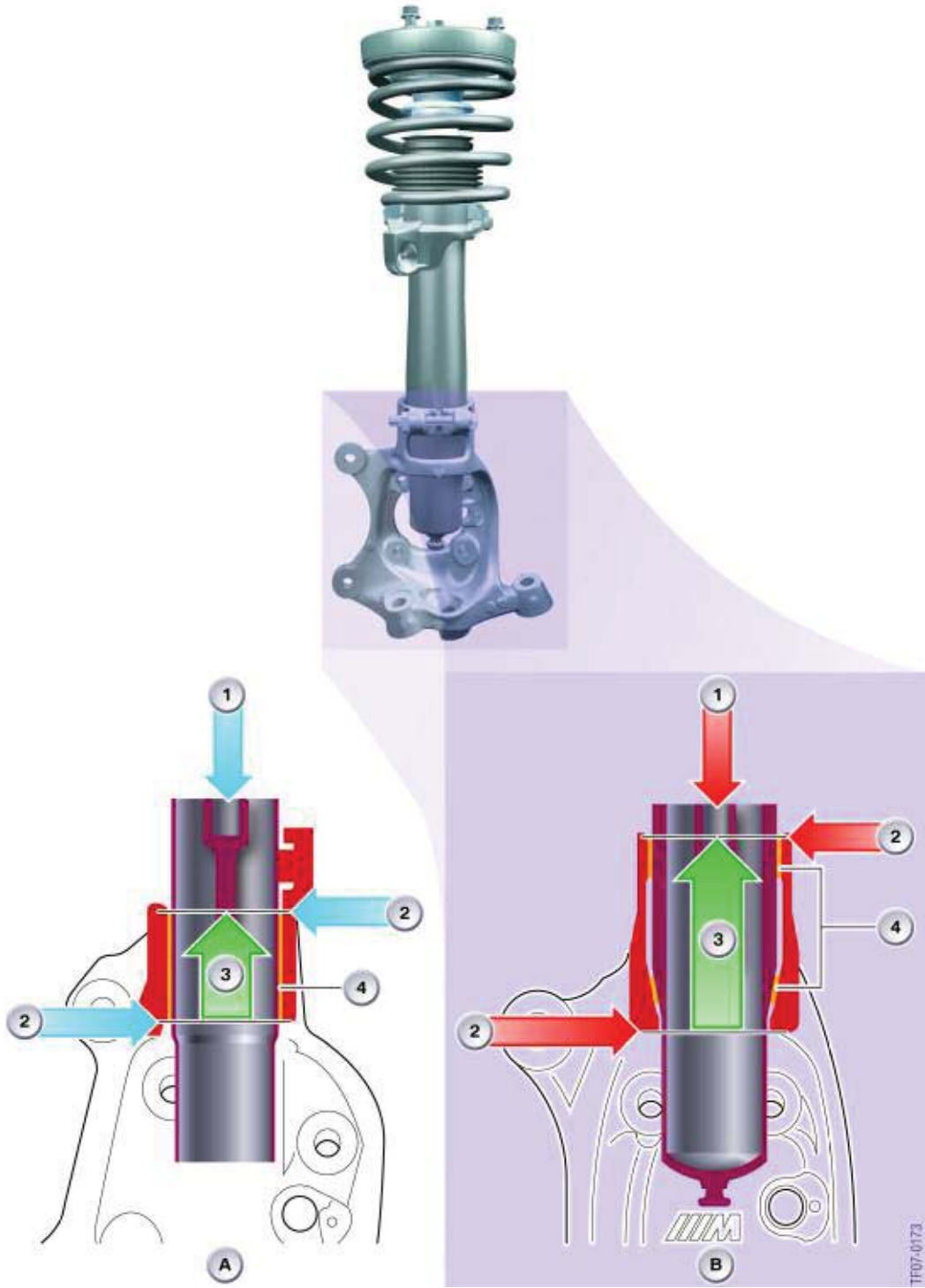
The front steel suspension spring has a 95 mm compression and 100 mm rebound travel. A new spring concept supports lateral chassis stability. Depending on the vehicle weight (equipment), modified spring types are used.



Index	Explanation
1	Retaining nut, shock absorber to support bearing
2	Dowel pin, support bearing to body
3	Mounting fixture, support bearing to body
4	Joint seat
5	Support bearing
6	Upper spring seat
7	Support disc
8	Additional damper/spring
9	Gaiter
10	Lower spring seat
11	Spring strut

M3 Front spring strut

Connection to the Wheel Carrier



Spring strut connection to the wheel carrier compared to the E92 series model

Legend for graphic on previous page

Index	Explanation	Index	Explanation
A	Spring strut support in the E92 series model	A	Spring strut support in the E93 M3
1	Vertical force (Z-axis)	1	Vertical force (Z-axis)
2	Upper and lower limit for supporting lateral and longitudinal force (X and Y axis)	2	Upper and lower limit for supporting lateral and longitudinal force (X and Y axis)
3	Clamp height 52 mm parallel fit	3	Clamp height 76 mm with parallel upper and conical lower fit
4	Parallel contact face	4	Upper cylindrical and lower conical contact face

As shown in the diagram, the clamp height has been increased on the Z-axis from 52 mm on the series E92 (left) to 76 mm on the E92 M3 (right).

The front spring strut now has an additional support. The wheel carrier has also been modified to compensate for the increased drive and dynamic forces.

The lower contact face of the spring strut in the E92 M3 has a cone, which is positioned firmly in the wheel carrier. In the series E92, however, the front spring strut has a parallel construction and is only held in place by the clamping force.

This design change and the increased clamp height accommodate the increased reaction forces of the spring strut and increase the overall stability of the wheel suspension.

During assembly, the M3 spring strut is pulled into the lower cone using a new special tool.

Note: Follow the new installation and removal process according to the service repair manual.

Tension Strut

The tension strut is similar to that used in the series E92, but features an 'M'-specific harder rubber mount.



Wishbone

The M control arm is completely new and is connected to the axle carrier and wheel carrier by two ball joints. It is manufactured out of forged aluminum alloy.



Wheel Bearing Unit

The M3 wheel bearing unit is identical to the E60 M5 wheel bearing unit. It has three dowel pins for the brake disc.



Front Anti-roll Bar

The weight-optimized front anti-roll bar was adapted for the M3 and has a special rubber bearing material for more direct response. The hinged brackets are made out of an aluminum alloy (series E92 steel).



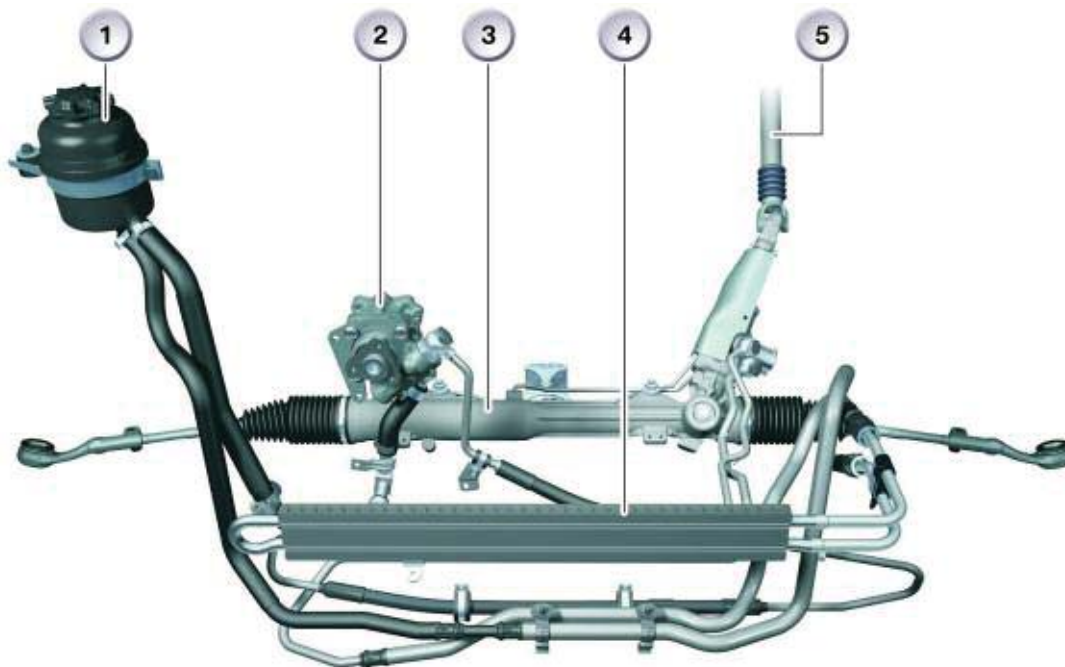
Steering

The design of the rack-and-pinion steering system is the same as the series E92. The average variable overall ratio is 12.5 and hence sports-oriented (16 in the series E92).

In the M3, the steering force support is controlled by the MSS60 via the Servotronic valve. A speed dependent characteristic curve is stored in the MSS60 for this purpose. With the MDrive menu option, a second and even more sports oriented characteristic curve can be activated (see the chapter on MDrive).

The steering oil is guided through a steering oil cooler before it returns to the oil reservoir.

The E92 M3 is not available with active steering.



Index	Explanation
1	Steering oil header tank
2	Steering oil hydraulic pump
3	Steering transmission housing
4	Steering oil cooler
5	Steering wheel spindle

Rear Axle

Rear Axle Carrier

The rear axle carrier is constructed from steel sections which are welded together. All mounting points for the rear axle and suspension components are formed or attached to the axle carrier making it an integral component.

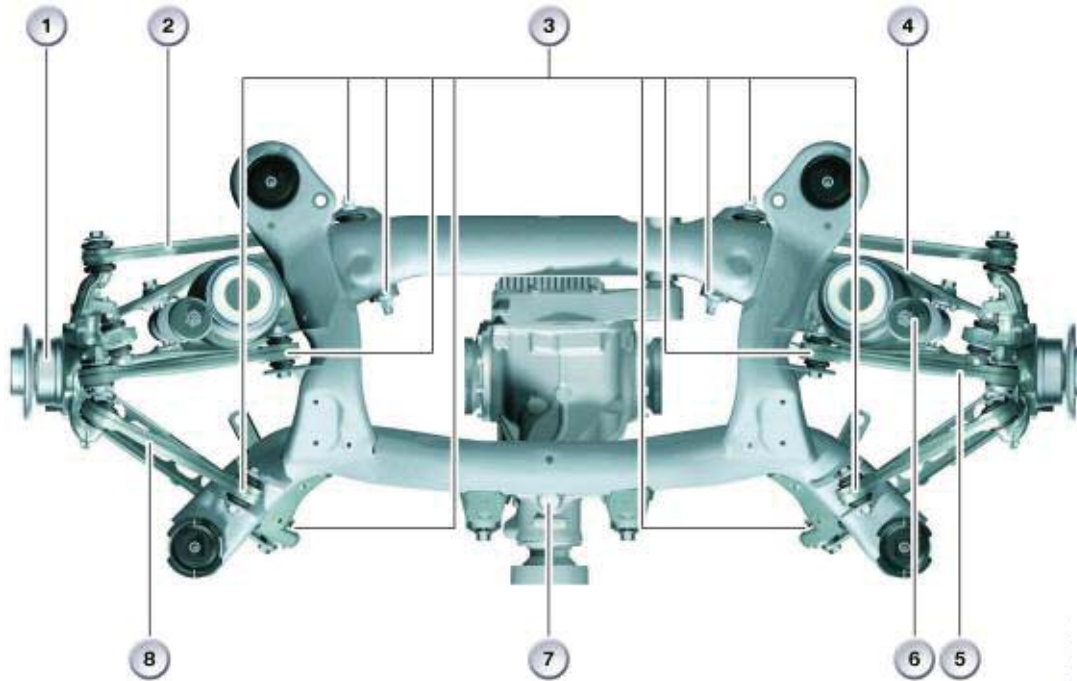
Nearly all components of the rear chassis have been revised, the aim is to achieve optimum sports vehicle kinematics, chassis stability and a more precise and direct response, with a simultaneous reduction in weight.

This has been achieved by the careful selection of materials for the axle components and bearings, and through a modification of the axle geometry.



Designation	E92 M3	Series E92 335i
Tire type/Wheel rim type/Rim offset [mm]	265-40 ZR 18/9.5Jx18 / IS23	225-45 WR 17 RSC/8Jx17/ IS34
Tire radius [mm]	311	295
Wheelbase [mm]	2761	2760
Track width [mm]	1539	1513
Total toe	10'	18'
Driving axis angle	0°	0°
Camber	-1° 45'	-1° 30'

Construction of Rear Axle



Complete rear axle

Index	Explanation	Index	Explanation
1	Wheel carrier	5	Wishbone
2	Toe struts	6	Shock absorber
3	Connections from control arm to rear axle carrier	7	Rear axle carrier
4	Camber struts	8	Traction strut with semi-trailing arm below it

Wheel Carrier

The attachment points for toe, camber, wishbone, longitudinal and traction struts have been positioned specifically for the 'M' model.

Its overall dimensions allow for the larger M wheel to be fitted. The 'M' wheel carrier is fitted with a modified rubber mount connecting to the semi-trailing arm and a ball joint for the camber strut.

Toe Struts

The new 'M' toe strut is forged from Aluminum. It is one-piece and has two integrated ball joints.

Camber Struts

The 'M' camber strut is a new lightweight component forged from Aluminum. Its design reduces the unsprung mass of the vehicle.

Wishbone

The new 'M' wishbone is forged from aluminum and has a modified integrated ball joint and a rubber mount.

Control Strut

The semi-trailing arm is the only rear suspension strut that is taken from the series E92. It is connected further inwards on the rear axle carrier, only the rubber mount is new.

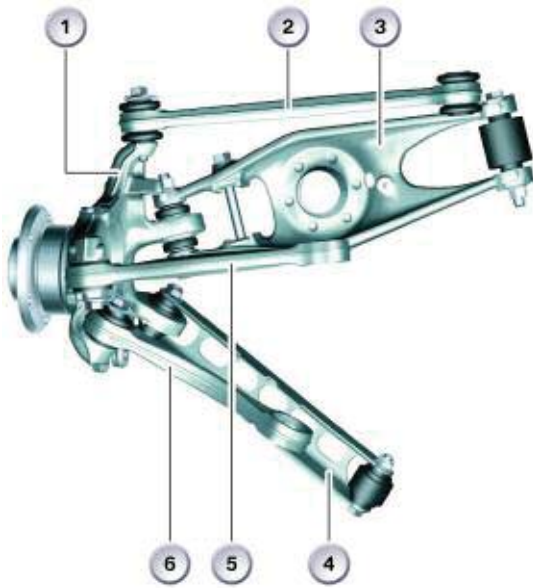
Traction Strut

The geometry of the forged aluminum 'M' traction strut has been revised. It now has a new integrated rubber mount for the wheel carrier. The ball joint for the rear axle carrier has been taken from the series E92.

Rear Shock Absorbers

New 'M' specific rear aluminum dampers are fitted to the M3. Electronic damper control - continuous (EDC-K), is available as an option.

The integrated lower damper rubber mount has a support sleeve that improves the rigidity and stability between the damper and the camber strut.



Overview of rear axle struts

Index	Explanation
1	Wheel carrier
2	Toe strut
3	Camber strut
4	Control strut
5	Wishbone
6	Traction strut

Electronic Damper Control - Continuous (EDC-K)



EDC-K is available for the first time in the E92 M3. EDC-K is an option and is based on the EDC-K in the E65.

Both dampers of one axis are always activated in parallel. The valve is installed internally in the damper in the damper oil system.

The driver can choose between three settings, the controlled programs "Comfort" and "Normal", or the uncontrolled fixed setting "Sport".

The program is selected using the EDC-K button on the center console or preset via the MDrive menu and activated using the M button on the steering wheel (for more information, see the MDrive chapter).

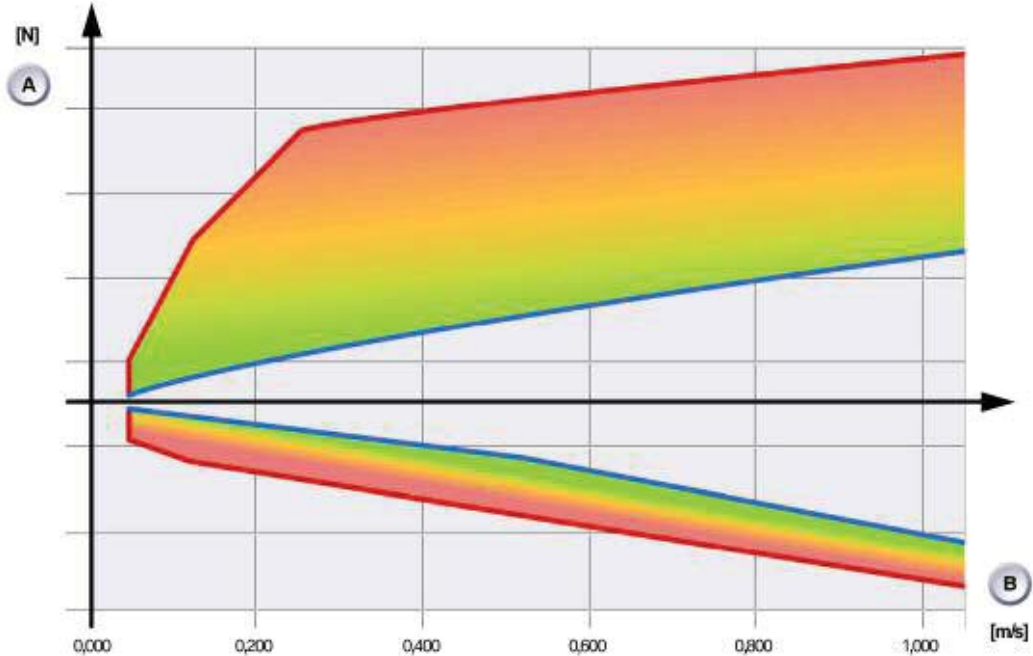
The input signals come from two vertical acceleration sensors in the front wheel arches and a third sensor in the rear right-hand wheel arch.

The steering column switch cluster sends the steering angle to the F-CAN. This is transmitted together with the wheel speeds from the DSC to the PT-CAN and evaluated in the EDC-K control unit.

The longitudinal, lateral and vertical accelerations calculated as a result are used as a basis for regulation.

The EDC-K button signal enters the junction box and is transmitted to the EDC-K on the PT-CAN.

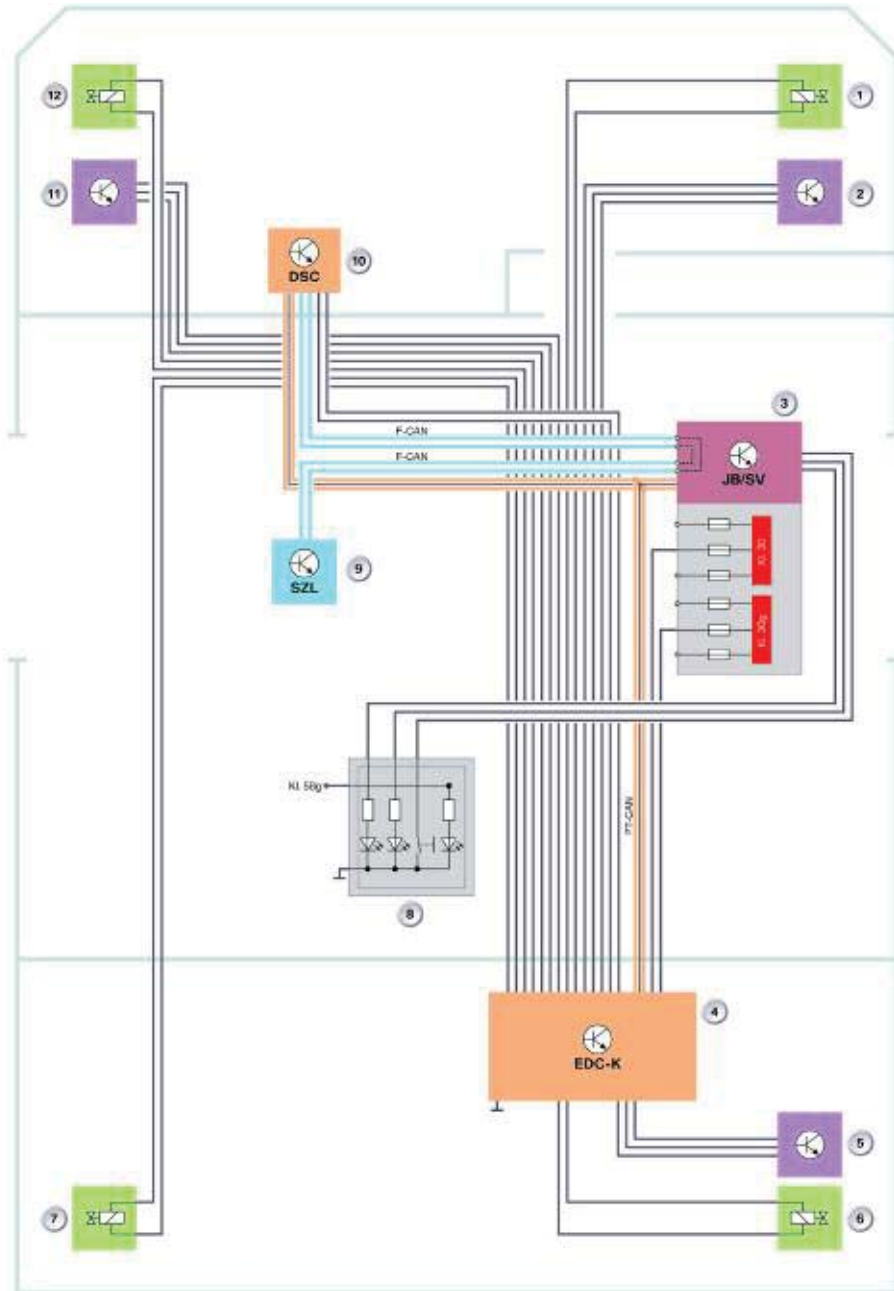
Damping behavior characteristic map



Index	Explanation
A	Damping force rebound phase (above) and compression phase (below)
B	Damper piston speed

The compression phase, and in particular the rebound phase, of the shock absorbers can be adjusted by the EDC-K depending on the input signals in a smooth transition from relatively comfortable to a harder sports setting.

EDC-K System Circuit Diagram



Index	Explanation	Index	Explanation
1	EDC valve, front right	7	EDC valve, rear left
2	Vertical acceleration sensor, front right	8	EDC button on center console
3	Junction box/distribution box	9	Steering column switch cluster
4	EDC-K control unit	10	DSC control unit
5	Vertical acceleration sensor, rear left	11	Vertical acceleration sensor, front left
6	EDC valve, rear right	12	EDC valve, front left

Wheels, Tires and Brakes

Wheels and Tires

In the standard version, the cast 18" 'M' double spoke wheel (style 260) is available for the E92 M3, with the forged and polished 19" 'M' double-spoke wheel (style 220) available as an option. These are weight-optimized M3 light alloy wheels.

The tires are also specifically selected for the M3. The Michelin Pilot Sport (PS2*) is currently fitted.

Wheel/tire Specification

Standard wheel:

Front - Wheel: 8.5 J x 18; IS 29; EH2+
Tires: 245-40 ZR 18

Rear - Wheel: 9.5 J x 18; IS 23; EH2+
Tires: 265-40 ZR 18

Optional:

Front - Wheel: 8.5 J x 19; IS 29; EH2
Tires: 245-35 ZR 19 XL

Rear - Wheel: 9.5 J x 19; IS 23; EH2
Tires: 265-35 ZR 19 XL



Brakes

For the E92 M3, the M Compound brake system with perforated brake discs and three 'M'-typical brake pad wear sensors is used, with a specifically adapted operating principle and dimensions.. The diameter of the brake discs has increased compared to the E46 M3 by 35 mm at the front, and by 22 mm at the rear.



Brake System Specification

Front brake: Diameter 360 mm, thickness 30 mm, direction-specific ventilation, single-piston floating caliper (lightweight metal alloy), brake pad wear sensor right and left.

Rear brake: Diameter 350 mm, thickness 24 mm, direction-specific ventilation, internal handbrake with 185 mm diameter (similar to E60 M5), single-piston floating caliper (cast metal alloy), brake pad wear sensor on right.

Dynamic Stability Control (DSC) MK60E5

The E92 M3 is equipped with the MK60E5 DSC system made by Continental Teves, which has been specifically adapted to its driving dynamics. The "civilian" version is installed in several models including the 6-cylinder series E92 and an M-specific version is installed in the E6x M5 and M6.

The fundamental difference in both versions is the replacement of Dynamic Traction Control (DTC) with M Dynamic Mode (MDM). MDM has been adapted to suit sports car dynamism for experienced sports drivers. The permitted float angle and longitudinal slip in good environmental conditions (road, weather, etc.) are also equally high.

Furthermore, the driving-performance control (FLR), soft stop and Fading Brake Support (FBS) functions are not required in the 'M' version.

The braking readiness, "apply the footbrake and the handbrake until the discs and drums are dry" and the gradient assistant functions have been adapted appropriately.